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AN APPARENTLY NEW *THRAULODES* FROM ARIZONA (EPHEMERIDA) *

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Recently I received from Mr. J. Sperry a small series of a *Thraulodes* species from Arizona which, while apparently very closely allied to *speciosus* Trav. in genitalia, as far as can be told from the rather crude figure (Biol. of Mayflies, 553, fig. 146), does not fit in with Traver's description in several points. I am treating it therefore as undescribed.

Thraulodes arizonicus sp. nov.

Male. (dried) Head pale creamy (not blackish as in *speciosus*) with bright brown tinges along the margins of the ocelli and at the bases of the pale antennae; lower eyes black, upper eyes red-brown. Pronotum light brown with paler mesial shade and tinges of smoky shading laterally; mesonotum light brown, bordered with creamy in anterior portion and with creamy shading before and on the scutellum; metanotum light brown with creamy shading anteriorly. Pleura brown with creamy shading in the sutures, especially anterior to forewing-base and between second and third pairs of legs, which area also shows some blackish strigulations. Prosternum pale creamy; mesosternum with anterior half creamy, posterior half bright brown, narrowly bordered laterally with creamy; metasternum creamy. Forelegs creamy at base, femora pitch-brown, tibiae paler yellow-brown, tipped at both ends with darker, tarsi entirely pale (not touched with brown as in *speciosus*). Mid and hind legs pale at base with slight smoky shade, femora amber, faintly tinted with brown in middle section with a broad strong band of brown terminally, tibiae and tarsi pale amber.

Abdomen with first segment light brownish. Segments 2-6 pale hyaline, with lateral oblique smoky streaks, decreasing in size towards rear of abdomen and with very narrow smoky posterior margins; smoky ganglionic patches visible mid-ventrally. Segments 7-10 rather bright brown dorsally, segment 8 crossed by a broad creamy band, leaving only a narrow brown anterior margin, other segments with small creamy lateral triangular patches; ventrally largely creamy, except segment 9 which is shaded with brownish. Forceps pale amber with terminal joints smoky, penes pale brownish. Setae pale amber, clearly ringed with pitch-brown.

Wings hyaline; on primaries longitudinal veins faintly brown, all cross-veins fine and deeper brown; humeral vein surrounded by a small smoky patch; about 6 costal cross-veins before bulla, all definitely smoky but not more prominently so than other cross-veins; pterostigmatic veins with slight tendency to anastomosis. Secondaries with pale venation except the humeral vein and a small section of the vein on which it rests which are blackish.

Holotype—♂, Oak Cr. Canyon (near Flagstaff) Ariz., June 15, 1941, (G. and J. Sperry); No. 5322 in the Canadian National Collection, Ottawa.

Paratypes—6 ♂, same data.

The characteristic pale band on the eighth abdominal segment found in this species is not noted as being present in *speciosus* Trav. and should readily serve to distinguish the two species.

*Contribution No. 2162, Division of Entomology, Science Service, Department of Agriculture, Ottawa.

THE CANADIAN APPLE MEALYBUG, *PHENACOCOCCUS ACERIS* SIGNORET, AND ITS ALLIES IN NORTHEASTERN AMERICA

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Within the past few years, two species of mealybugs have become serious pests of apple in North America. In Virginia, for some apparently unknown reason, the Japanese Comstock mealybug, *Pseudococcus comstocki* Kuwana, has undergone a change in its feeding habits and produced a strain that has become well adapted to feeding and reproducing on apple. In Canada the apple mealybug, *Phenacoccus aceris* Signoret, which apparently first gained entrance from Europe into Maine and has spread into Nova Scotia and British Columbia, has become a serious pest of apple, cherry, and to some extent currant. Since in Europe it is known that the apple mealybug occurs on a large number of fruit, shade and forest trees, the aim of this paper is to give a taxonomic account of *aceris* which will aid in the determination and separation of the insect from allied species found on various hosts in northeastern America. It is also the purpose of this paper to give the distribution and economic importance of *aceris* in various parts of the world. A brief account is given of the immature larva of the apple mealybug parasite, *Allotropa utilis* Muesebeck.

TAXONOMIC ACCOUNT

Generic Concepts. At the present time there is considerable confusion regarding the identity of mealybugs of the genera *Phenacoccus* Cockerell and *Pseudococcus* Westwood. This is due to the misunderstanding of the characteristics that are of taxonomic value in the determination of the various species of these two genera. In order to use the characteristics of greatest taxonomic value it is necessary to properly prepare, stain, and mount on slides the insects to be observed, since the most distinctive structures are usually very minute. Among the most important of the structures useful in the determination of species are the chitinous areas usually found in the anal lobes about the cerarii, the number and location of the triangular, quinquelocular and multilocular pores, and the type, size, number and location of the tubular ducts. In addition, where the generic relationships of a species was not very well understood, it was generally placed in either one of the above genera in order that no additional genera would have to be established. In the genus *Phenacoccus* there are over 125 names for species, while in *Pseudococcus* there are over 325 names. Many of the names may eventually be reduced to synonymy. The confusion existing in the placement of species into a genus is particularly noticeable in the *Phenacoccus*. The following are considered to be the characteristics of that genus: 1, Nine-segmented antennae; 2, Eighteen pairs of cerarii along the submarginal borders; 3, Anal ring lacking the lateral orbaceroris but surrounded by numerous minute tubercles; 4, Quinquelocular pores present on the venter and about the spiracles; 5, Each tarsal claw with a tooth along its inner margin; 6, No very large tubular ducts present; 7, The base of each seta surrounded by a cup-shaped cavity which is broader at its base than at the top.

In the writer's collection are the following species which have been placed in *Phenacoccus* but which do not conform in one or more of the above characters: *dearnessi* King of northern U. S., *glomeratus* Green of Ceylon, *hirsutus* Green of the Orient and Egypt, *hystrix* Barensprung (?) of western Germany, *iceryoides* Green of Ceylon, India, Straits Settlement and Tanganyika Territory, *inermis* Hall of Egypt, *insolitus* Green of Ceylon and India, *piceae* Loew of Europe, *serratus* Ferris of northeastern United States, *stachyos* Ehrhorn of the United States.

Phenacoccus aceris Signoret

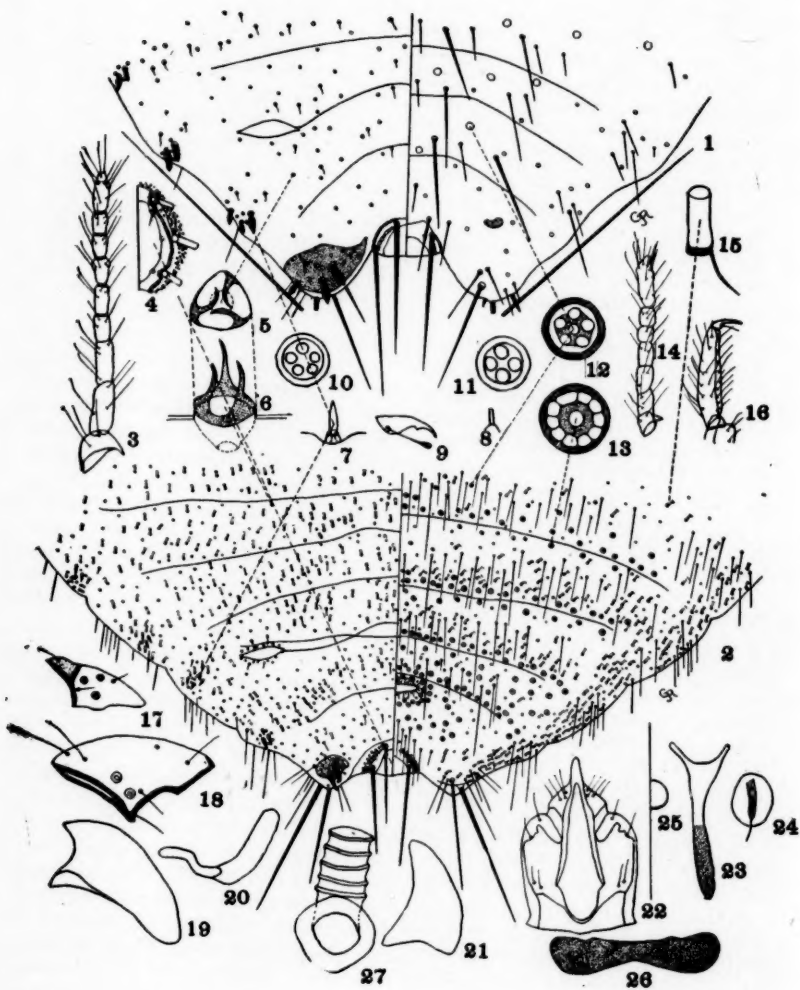
Adult female in life: a longitudinal, medial dorsal ridge of cottony secretion; laterad of dorsal ridge, body irregularly covered with cottony secretion

which is lacking in some of the areas of articulation where the body color appears to be green. Ovisac long and well developed, arising from the under side of the abdomen. Oviparous. Specimens killed in KOH or alcohol turn green; those boiled in water turn brown.

Morphological characters (adult, fig. 2): Length 2.76-3.30 mm.; width 1.84-2.38 mm. Antennae nine segmented (fig. 3); legs subequal, tarsal claw with a tooth on the inner margin and a pair of digitules dilated at their distal ends (fig. 9). Body with eighteen pairs of submarginal, dorsal cerarii, each containing two spines, rarely three or four, in addition to from five to ten triangular pores, one or two auxiliary spines and no setae, the number of pores and the size of the spines gradually decreasing toward the anterior part of the body; each pair of cerarii of the anal lobe surrounded by a medium sized, irregular, ovoid, chitinous area containing a pair of large conical spines, from three to four auxiliary spines, numerous triangular pores and one or two small setae arising from the border of the chitinous ovoid area furthest from the medial line; from the ventral side at the apex of the anal lobe projects the anal lobe seta 230 to 270 microns long, an auxiliary seta 180 microns long, and an additional five to seven auxiliary setae 100 microns long; on the ventral side opposite each of the fifteenth, sixteenth and penultimate pair of cerarii are groups of from five to six long setae. Anal ring normal, dorso-ventral, lacking the lateral orbaceroris but surrounded by numerous minute tubercles (fig. 4); with three pairs of setae from 160 to 170 microns long. Multilocular pores numerous, present in the ventral abdominal region (fig. 13). Quinquelocular pores sparsely distributed over the venter, especially in the region between the antennae and the legs spiracles, and several of the anterior abdominal segments, absent from the last two abdominal segments and the regions laterad of the antennae and legs (fig. 12). Triangular pores (fig. 5, 6) generally distributed over both sides of the body, more abundant dorsally. Tubular ducts present both dorsally and ventrally, very abundant dorsally except on the last abdominal segment where there are a small group of three or four just anterior to each of the chitinous areas of the anal lobe cerarii; on the fifth, sixth, and seventh abdominal segments the tubular ducts occur in several longitudinal series, one extending along the medial line, a pair laterad of the medial group and another pair along the submarginal border extending to the ventral side, otherwise irregularly distributed over the dorsum; ventrally less abundant except along the submarginal borders, present in small numbers interspersed with the multilocular pores, also present in the region between the antennae and the last pair of legs where they appear to be of smaller diameter but of greater length. Dorsal body setae small and spear shaped, not numerous, scattered over the body, the base of each seta surrounded by a cup-shaped cavity which is broader at its base than at the top; cerarial and auxiliary spines similar in structure; ventral body setae comparatively much longer and more slender than the dorsal body setae, especially in the region between the antennae and the mouth parts where they reach their greatest length and occur in a large cluster, in great numbers in the abdominal area, a group of seven being present just cephalad of the anal ring in addition to several groups, each following the segmentation of the abdomen, in small numbers over the other parts of the body. Two ventral circuli present, the larger ovoid, found in the medial region just posterior to the last pair of legs, the other anterior to it, smaller in size and either circular or ovoid in shape. Ventriculus quadrate.

Second or overwintering stadium (fig. 1): Length .88 to 1.03 mm.; width .50 mm. Antennae seven-segmented (fig. 14). Legs subequal, proportionally stouter than in the adult insect; tarsal claw with a tooth on the inner margin and a pair of digitules dilated at their distal ends. Body with eighteen pairs of dorsal marginal cerarii, of which all except the third contain a pair of spines,

PLATE IX.

*PHENACOCUS ACERIS* SIGNORET AND ALLIES

each of the third pair of cerarii usually with three spines; no auxiliary spines present in the cerarii, except in the last pair where one or two may be present in the chitinous area just laterad the base of the anal ring; ventrally, on the apex of the anal lobe, projects the anal lobe seta, an auxiliary seta, and an additional five setae; anal ring normal, with the lateral orbaceroris region present and with six setae. Multilocular pores absent; quinquelocular pores distributed over the venter, especially between the antennae and the last pair of legs but absent on the last abdominal segment and along the marginal and submarginal regions, not present on the dorsum (fig. 12); triangular pores well distributed over the dorsum and along the marginal and submarginal borders of the ventral side, apparently not present over the other parts of the venter (fig. 13); tubular ducts very sparse, one or two present medial of each of the coxal fossae and laterad of each of the spiracles, another pair found in the medial region of the fifth abdominal segment, also occasionally present singularly in the regions about the cerarii (fig. 15); dorsal body setae of the same shape and occurring in much the same manner and numbers as in the adult; ventral body setae similar to those found in the adult but not as abundant except for a large group in the area between the mouth parts and the antennae; crumena, together with the mandibular and the auxiliary bristles, extending to the sixth abdominal segment; ventral circulus caudad the last pair of legs, elongate ovoid in shape; ventriculus apparently not present..

Synonymy. In comparing the type material of the Japanese *Phenacoccus pergandei* Cockerell with *P. aceris*, the writer has been unable to find any characteristics to separate the two and considers the Japanese insect a synonym of *aceris*.

Males. The male of the genus *Phenacoccus* as it is considered in this paper has ten-segmented antennae and very degenerate mouth parts. The head and thorax are composed of a complex chitinous framework. The abdomen is fleshy and has no chitinous framework and no spiracles present. On the ventral surface of the thorax are two pairs of spiracles and a small number of circular pores which contain four loci, while in the abdomen along the margins are additional circular pores with five loci (fig. 10). On the preapical and preceding segment of the abdomen are two lateral tassels, each with several long setae and a small cluster of circular pores each of which has four loci and from which arise the long cottony tassels. The trochanter of each leg bears a rudimentary ridge running from side to side, dividing it into two parts. In the larger of the two parts there are three sensory pores on each face of the trochanter while in the adult female only two sensory pores are present (fig. 17, 18). The tarsi of each of the three pairs of legs are two-segmented; the claws are without teeth on their inner margins (fig. 16). The halteres are elongate and narrow, with one long slender narrowly hooked seta at their apices. The squamae take stain more readily than any of the other parts of the wing.

Although no critical examination was made of the structures of the adult males of the genus *Phenacoccus*, the size and shape of the penis appear to be the most reliable characteristics that can be used in the separation of the species. The penis of *aceris* is distinctly triangular in shape and with the inner margin concave and the outer margin convex (fig. 21). The penis of *hystrix* is very similar; however, it differs in that the lower part of the inner margin will take stain (fig. 19). The penis of *gossypii* is very similar in shape to that of *Pseudococcus*. It is elongate, and consists of two parts (fig. 20).

ECONOMIC IMPORTANCE

Within the last few years several outbreaks of *aceris* have occurred in British Columbia and Nova Scotia. The insect has become a major pest of apple and cherry, and to some extent, currant, in the Kootenay lake region of south central British Columbia where spraying operations have not been very

successful in controlling the insect. Damage by the insect is caused by the large amounts of a sticky "honey dew" which falls upon the foliage and fruit and forms an ideal medium for the growth of a black fungus that can only be removed from the fruit by the expensive process of washing. Another form of injury that the mealybug may cause is the premature dropping of the fruit and the death of some of the branches. In severe infestations of the fruit stem and branches, the flow of sap may be so arrested that either the fruit drops just before reaching maturity or the branches die.

The writer believes that the insect first gained entrance into North America through the introduction of apple stock from Europe into southern Maine some time before 1910, since he has seen specimens in the collection of the Maine Agricultural Experiment Station which were collected at Wiscasset in June, 1910, and at Brunswick on April 29, 1912. They were questionably determined as *dearnessi* King, an indigenous species which it does not in any way resemble (3). Whether the infestation in Nova Scotia is continuous with that in southern Maine or whether the two infestation are separate and distinct is unknown.

In Europe, where *aceris* is endemic, it is recorded from many species of fruit, shade and forest trees (8). It is a serious pest on peaches grown in the greenhouses of southern England (2) and outdoors in Holland (6). *P. pergandei*, a synonym of *aceris*, was first found at Tokyo, Japan, in 1893 on "Gumi" and magnolia by Dr. R. Takahashi and was described in 1896. It has since been found over most of the islands of Japan. Periodically, the insect becomes quite destructive to apple, *Prunus* and to some extent pear in Sapporo and neighborhood on the Island of Hokkaido. The insect is recorded as having been introduced into Japan, together with *Lepidosaphes ulmi* Linn., on apple stock from Germany in 1870. The economic importance and biology of the insect have been well described in Japan (4).

In Holland partial control of *aceris* on peach has been accomplished by the use of a dormant spray of one part carbolineum (a coal tar product) to twenty parts water, while the temporary control of the insect on vine (*Ribes* and *Vitis*) was had by the use of one part carbolineum to fourteen or sixteen parts water. In winter the painting of peach trees with five per cent soap and five per cent spirits in water has proved very satisfactory, the trees being completely cleared of the mealybugs (6).

In Japan *pergandei* (= *aceris*) is recorded as scarce on pear, probably because of the use of such insecticides as nicotine sulphate, derris and oil emulsions (9).

In 1933 the solitary parasite, *Allotropa utilis* Muesebeck was first reared in large numbers from *aceris* in Nova Scotia (1, 5). It is very similar to an undescribed species of *Allotropa*, a gregarious, possibly exotic, polyembryonic species which the author first bred from the Comstock mealybug in 1936 in the New York Metropolitan area. Recently, Doctor Muesebeck informed the author that a series of *Allotropa* reared from the Comstock mealybug in Japan in 1940 is similar to the species found on the Comstock mealybug in the New York Metropolitan area. There is also another species attacking the Comstock mealybug in Virginia which was recently introduced from Japan. *Allotropa utilis* passes the winter in the larval stage, while the local species goes through the winter in the pupal stage. Recently this parasite has been introduced into British Columbia.

The immature larva of *Allotropa utilis* is elongate; the mandibles are elongate, fleshy, the apical half slightly chitinous (fig. 23); antenna short, not projecting outside of the cavity and with a seta at its apex (fig. 24); one pair of spiracles present close to the mouth parts, each with a flat atrium and a stalk with from four to seven annular thickenings (fig. 27); a transverse, elongate sternal plate present on the first abdominal segment (fig. 26).

In Holland *Blastothrix schonherri* West. is recorded as being the most abundant parasite attacking *aceris* (7). It has also been recorded from the same mealybug over most of Europe.

KEY TO THE SPECIES OF PHENACOCOCCUS OF NORTHEASTERN AMERICA

1. With numerous very large tubular ducts; viviparous.....*stachyos* Ehrhorn
Without such ducts2
2. With more than 18 pairs of cerarii (20-24); oviparous; on *Fagus grandifolia**serratus* Ferris
With not more than 18 pairs of cerarii3
3. With from 6 to 10 pairs of cerarii apparent; viviparous; on *Crataegus* spp.*dearnessi* King
With 18 pairs of cerarii present4
4. With multilocular pores present only on the venter of the abdomen5
With multilocular pores present both ventrally and dorsally on the abdomen 6
5. Less than 75 multilocular pores present on the venter of the abdomen; no quinquelocular pores present either on the abdomen or near the spiracles; no groups of setae present on the submarginal borders of the venter opposite the dorsal abdominal cerarii; one ovoid circulus present; viviparous.....*colemani* Ehrhorn (?)
More than 100 multilocular pores present on the venter of the abdomen; quinquelocular pores present on the abdomen and near the spiracles; groups of setae present on the submarginal borders of the venter opposite the dorsal abdominal cerarii; two ovoid circuli present; oviparous*aceris* Signoret
6. Multilocular pores arranged in a transverse series of 14 to 26 circular groups on dorsum, each group containing from 4 to 6 multilocular pores; oviparous*saratogensis* Rau
Multilocular pores not arranged in circular groups on the dorsum7
7. Thin skinned, ovoid elongate, cerarii not very distinct, circulus apparently not present on the venter, legs and antennae small in proportion to the size of the body; oviparous; on *Acer**acericola* King
Moderately thick skinned, elongate, cerarii distinct, circulus very distinct on the venter, legs and antennae moderate in size in proportion to the size of the body; oviparous; found only in greenhouses in northern United States where it is a pest of *Chrysanthemum*.....*gossypii* Townsend and Cockerell

SOME SPECIES OF PHENACOCOCCUS INDIGENOUS TO NORTHEASTERN AMERICA

Phenacoccus acericola King. This insect is the common species found on maple. Before it was recognized as a distinct species, it was recorded as *aceris* so that any North American records of the European species previous to the description of this insect in 1902 should be referred to *acericola*. Occasionally, the insect becomes very abundant and quite troublesome on shade and ornamental maples. Under such conditions several species of lacewings and *Hyperaspis* are found feeding on the young mealybugs in large numbers. The ladybeetle, *Hyperaspis signata* Oliv., is the most beneficial predator attacking the maple mealybug. The maple mealybug passes through two generations a year and goes through the winter in the egg stage.

Phenacoccus colemani Ehrhorn. In northeastern United States this species is present in large numbers on various weeds. It has two generations a year, is viviparous, and passes the winter in the first larval stage. There is some question as to the identity of this species. The writer has been unable to rear any parasites from this mealybug. He has also specimens of the same species from British Columbia.

Phenacoccus dearnessi King. *P. dearnessi* was confused with *aceris* when it was first found in Maine and later in Canada. It is a rather large, robust, hemispherical species, which is dark red in color when crushed. Because of its shape, slide mounts show the dorsum to be very much larger than the ventral side. It is almost impossible to make out the characteristics in the type of this species, a young adult in the Museum of Natural History, New York City, since it is not stained and contains several immature parasites. The species is not very common, but is occasionally found in large numbers on *Crataegus*. It is viviparous and passes through one generation a year. The writer has been unable to rear any parasites from this insect in Metropolitan New York.

Phenacoccus gossypii (Townsend and Cockerell). The Mexican mealybug, *gossypii*, is among the most important of our greenhouse insects, especially on *Chrysanthemum*. It has gained entrance into our northern greenhouses within the last ten years and fortunately is not as widely distributed as other greenhouse mealybugs. In life it can be readily separated from the other greenhouse mealybugs by the presence of four longitudinally impressed lines on the dorsum, where the waxy secretion is absent, and by its grayish color when crushed. The writer has noticed, in the rearing of the Comstock mealybug on potato sprouts, that the Mexican mealybug occasionally infests these plants.

Phenacoccus saratogensis Rau. This mealybug is found on several species of grasses and is of interest because of its similarity to several European species. Other closely related exotic species are: *chersonensis* Kiritschenko from Odessa and the Crimea, *locustus* James from Kenya Colony, and *priesneri* Laing and *zillae* Hall from Egypt. *P. saratogensis* is oviparous and has two generations a year. Of parasites attacking this insect, the writer has reared the following: *Aphycoideus* sp., *Aenasius* sp. and an undetermined encyrtid.

Phenacoccus serratus Ferris. This is a common species found on beech, *Fagus grandifolia*, in northeastern United States. In slide mounts it can be very easily separated from other species by the greater number of cerarii. The young stages occur in the crevices, especially along scars where new layers of bark cover a wound. Here they are occasionally attended by ants and shielded by bits of soil, leaves, etc., deposited by the ants. When the mealybugs mature, they migrate to the trunk of the tree where they lay their eggs. Among the parasites that the writer has reared from this species are *Homalotylus* sp. and *Leptomastidea* sp. It is of interest that *Homalotylus* should be reared from a mealybug, since this genus has usually been considered as parasitic on Coccinellidae, but in this case, several specimens of a new species of *Homalotylus* were definitely reared from *serratus* in gelatin capsules.

Phenacoccus stachyos Ehrhorn. This species is not very common and the writer has collected it only once, at Saratoga Springs, New York. In slide mounts it can be separated from other species by the large tubular ducts which also make it quite distinct in life, since from these tubular ducts arise the glassy, rod-like threads not found in other species of this genus. However, this characteristic does not separate it from mealybugs of other genera, as there are several other species with the same glassy, rod-like threads projecting from the dorsum.

ACKNOWLEDGMENTS.

Acknowledgements are due Dr. Arthur Gibson, Dominion Entomologist, Canada, for specimens of the apple mealybug and the immature larval stages of *Allotropa utilis* Muesebeck. Dr. Gibson also furnished the author with valuable information on the life history, distribution, hosts, and damage caused by the insect. Thanks are also due Dr. F. H. Lathrop, Entomologist at the Agricultural Experiment Station, Orono, Maine, for the loan of the slides of mealybugs in the collection of the Experiment Station. The author is indebted to Mr. C. F. W. Muesebeck, Division of Insect Identification, Washington, D. C., for an

opportunity to study the type of *P. pergandei* Cockerell and to Dr. S. Kuwayama, Entomologist in Charge, Hokkaido Experiment Station, Sapporo, Japan, for additional material of *pergandei*. Sincere appreciations are due Mr. E. E. Green, of Surrey, England, Dr. P. Vayssiere of the Paris Museum, France, and Dr. T. Thomsen of the University of Copenhagen, Denmark, for material, slides, and the loan of authentically determined European specimens of *aceris*.

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EXPLANATION OF PLATE IX

Fig. 1 to 18, 21 and 22, *Phenacoccus aceris* Signoret. 1, overwintering or second stadium. 2, adult or fourth stadium. 3, antenna of adult female. 4, anal ring of adult female. 5 and 6, triangular disc pore, from above and from the side. 7, cerarial spine. 8, body seta. 9, tarsal claw of adult female. 10, disc pore from abdomen of adult male. 11, disc pore from thorax of adult male. 12, quinquelocular pore. 13, multilocular pore. 14, antenna of second stadium. 15, simple tubular duct. 16, tarsus of adult male. 17, trochanter of adult male showing three sensory pores. 18, trochanter of adult female showing two sensory pores. 21, penis. 22, ventral aspect of abdomen showing sheath and penis.

Fig. 19, penis of *Phenacoccus hystrix* Barrensprung.

Fig. 20, penis of *Phenacoccus gossypii* Townsend and Cockerell.

Fig. 23 to 27. Larva of *Allotropa utilis* Muesebeck. 23, mandible. 24, antenna. 25, mouth. 26, sternal plate. 27, spiracle.

NEW OR INSUFFICIENTLY KNOWN NEARCTIC SPECIES AND SUBSPECIES OF AGABUS (COLEOPTERA, DYTISCIDAE) *

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SUMMARY

Two subspecies of *Agabus seriatus* (Say) are recognized, *A. s. seriatus* from Manitoba eastward and southward, and *A. s. intersectus* (Crotch) from Manitoba west to British Columbia and south to New Mexico. *A. pandurus*, allied to *brevicollis* Leconte, and *A. vandykei*, allied to *verisimilis* Brown, are described from California. Additional characters are given to separate *A. griseipennis* Leconte and *lutosus* Leconte, and a new subspecies of the latter is named from British Columbia. *A. obliteratus* Leconte is discussed, and two related species, *nectris* from British Columbia, and *hoppingi*, from California, are described. *A. obsoletus* Leconte is recognized as valid, and distinguished from *morosus* Leconte. New localities for *A. ancillus* Fall are given. The aedeagus of the male genitalia of most of these species is illustrated.

*Contribution No. 2166, Division of Entomology, Science Service, Department of Agriculture, Ottawa, Ontario.

Agabus seriatus seriatus (Say)

Colymbetes seriatus Say, 1823. Trans. American Philosophical Soc. 2 (N. S.):97.

Agabus striatus Aubé, 1838. Species gen. des Coleopt., 6:305.

Agabus arctus Melsheimer, 1844. Proc. Acad. Sci. Philadelphia, 2:27.

Agabus parallelus Leconte, 1850. Gen. remarks.....in: L. Agassiz's "Lake Superior.....", Part 2, Sect. 4:213.

In 1853 Leconte, as editor of F. E. Melsheimer's *Catalogue of the described Coleoptera of the United States*, therein placed *A. striatus* as a synonym of *seriatus*, a view suggested by Aubé in his original description. In 1859, as editor of the collected works of Thomas Say (Vol. 2, p. 511), Leconte again mentioned *striatus* as a synonym, and added *arctus* Melsh. Sharp (1882) placed *parallelus* as a synonym of *seriatus*; it was so given by Henshaw 1895, in the third supplement to his List, but not in the original (1885). I have not seen type material of any of these species, but after a critical reading of the original descriptions I accept the synonymy.

Say's collections are considered to be lost, and it is desirable to designate a neotype of *Colymbetes seriatus* Say. Dr. Richard Dow was so kind as to examine the specimens and manuscript notebook in the T. W. Harris collection, and reports the following entry: "u 1303 *Colymbetes seriatus*, S. It agrees much better with ambiguous Say, being more acute behind than obtusatus. Cambridge June 1. 1832. on leaves of a tree in evening." The *u* is in red, indicating that it was one of the uniques sent to Say in November, 1833. "*Colymbetes*" is partially underlined in red showing that Say agreed with Harris on the generic name. Also in red is "*seriatus*, S." which indicates that this is the specific name given by Say. Unfortunately this specimen is not to be found in the present Harris Collection. There are now two specimens of *seriatus* in the collection; they are indicated as coming from Pennsylvania, and were received from Dr. Melsheimer, apparently in 1839. This is of interest in that Say's type was sent to him by Melsheimer; one wonders that the latter would redescribe the species as *arctus*, from Pennsylvania examples.

Dr. Dow has suggested that I use a modern specimen in good condition. Accordingly I hereby designate as the NEOTYPE of *Colymbetes seriatus* Say, 1823 (= *Agabus seriatus* (Say)), a male from North Lebanon, N. Y., June 8, 1938, collected by K. F. Chamberlain. This is deposited in the Museum of Comparative Zoology, Cambridge, Mass.

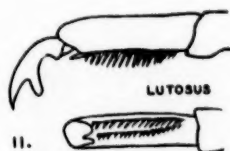
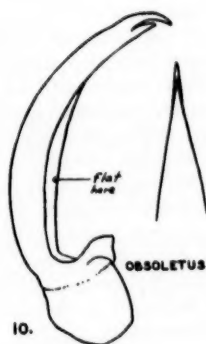
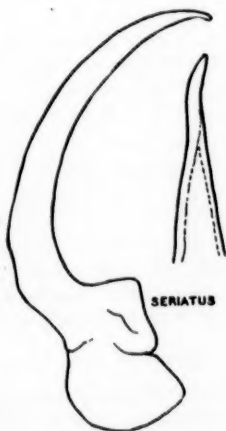
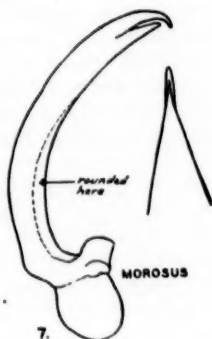
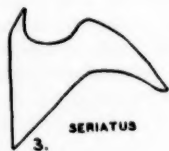
A. s. seriatus is one of the commonest of the eastern species of *Agabus*, and it does not seem necessary to redescribe it in detail. The metasternal wing (fig. 3) is rather narrow and shows but little variation; the aedeagus is shown in fig. 8. As known to me, the subspecies occurs from Manitoba and Minnesota south to Illinois, and east to Labrador, Newfoundland and the District of Columbia. A long series from Duparquet, Que., collected by Mr. G. Stace Smith, is darker, and has the elytral reticulations more deeply impressed, than in examples from New York and neighbouring States.

Agabus seriatus intersectus (Crotch) (new combination)

Gaurodytes intersectus Crotch, 1873. Trans. American Ent. Soc. 4:419.

In describing *intersectus* from Leconte's material, Crotch gave the range of the species as "California, Wyoming, Utah, Indian Territory, Oregon", but no single type specimen was selected. He described the male anterior protarsal claw as dentate. Fall (1922. Rev., N. Am. spp. *Agabus*, etc., p. 14) accepted a Lecontean male from Oregon as the type, and said that it was from "Eastern Oregon", though upon what authority I do not know. He also said "The tooth of the anterior tarsal claw (♂) mentioned by Crotch as a distinguishing character is only a particle of adhering foreign matter, the form of the claw being really precisely as in *seriatus*."

PLATE X.



NEARCTIC SPECIES OF AGABUS

Dr. Darlington has examined Leconte's series for me, and reports as follows: "Leconte's first specimen of *A. intersectus* is a female with a blue label, which is supposed to signify Oregon and vicinity. It is, however, exceptionally narrow for a western specimen, and on the basis of appearance and measurements it matches better with specimens from the east." The fourth in the series is a male labelled "Or", and is probably the one referred to by Fall. Acting upon a suggestion from Dr. Darlington, I am designating as the **LECTOTYPE** of *Gaurodytes intersectus* Crotch (= *Agabus intersectus* (Crotch)), the second specimen in Leconte's series, "a female labelled merely 'California', with a narrow red mark on the right hand edge of the label. There are two more specimens from the same series, that is, with similar pins and similar types of label, one with an identical red mark like that on the suggested type, in our general collection. I believe that these specimens were also seen by Crotch, but there is nothing on them to prove it. . . . The advantage of designating Leconte's Californian specimen as type is that it appears to be a typical western individual in appearance and measurements." Thanks to Dr. Darlington, I have been able to borrow the two specimens from the general collection, a male and a female, and have them before me.

A. seriatus intersectus normally has broader metasternal wings than *seriatus seriatus* (compare figs. 3 and 4); in fact it is very similar to *lugens* Leconte in this respect, and I have seen specimens so identified. In addition, it averages smaller, is more oval and less parallel-sided, has a slightly narrower pronotum the hind angles of which are usually rectangular instead of slightly acute, and is less shining dorsally. These characters show some variation in large series, and no one of them will separate the two subspecies in all cases. The shape of the metasternal wing is the most reliable, but Mr. J. B. Wallis has submitted a most interesting series from Manitoba (chiefly Aweme) showing intermediates in this and other characters; some specimens from Sante Fe, N. M., and Navajo Co., Ariz., have relatively narrow metasternal wings. The shape of the apex of the aedeagus is also variable, and I have not been able to use it to differentiate the subspecies.

As known to me, *A. s. intersectus* occurs in British Columbia, Alberta, Washington, Oregon, Idaho, Montana, South Dakota, California, Nevada, Utah, Colorado, Arizona and New Mexico. Fall stated that he had not seen specimens from the true Pacific fauna south of Victoria, B. C., but I have a male collected by J. R. Helfer at Mendocino, Calif. I do not know whether or not the subspecies goes far north in British Columbia, and thence eastward to join the eastern form in northern Manitoba. My most northerly example is a male taken by my brother at Skunk Lake, in the Manson River district of B. C., about Lat. 56°, Long. 124°.

***Agabus pandurus* n. sp.**

Agabus brevicollis Sharp 1882, nec Leconte 1857.

A large black species, resembling *A. brevicollis* Leconte, with which it was confused by Leconte. The male which Leconte sent to Sharp as representative of *brevicollis* is *pandurus*; it is in the Leconte collection, labelled "Type mihi, D.S." Dr. P. J. Darlington, Jr. has examined this specimen, and the male type of *brevicollis* Leconte, for me.

Female. Length 10.0 mm.; width 5.5 mm. Body broadly oval, moderately convex, surface shining. Black, not aenescant; mouth parts, front edge of labrum, antennae, and two spots on vertex, rufous; anterior angles of pronotum rufous; each elytron with an elongate postmedian sublateral yellowish spot; undersurface rufous to rufo-piceous, metacoxal plates and abdominal sternites darkest. Head five-eighths as wide as pronotum; meshes of surface reticulation irregular in size and shape; punctation fine and sparse. *Pronotum* three-eighths

as long as broad; sculpture as on head, except for the usual series of coarser punctures paralleling anterior margin and basal margin at each side of middle. Lateral marginal bead broad, widest at middle, about as wide as a median antennal segment. Hind angles slightly less than rectangular. Elytral sculpture more deeply impressed than that of head or pronotum, meshes of irregular shapes but much more uniform in size; the usual longitudinal series of coarse punctures present. Prosternal process spear-shaped, tip acuminate; narrowly margined from just behind front coxae to near apex, and appreciably convex. Metasternal wings rather narrow (fig. 1); least distance between mesocoxa and metacoxal plate slightly less than one-quarter the width of latter, measured along same line. Metacoxal plates faintly strigate, roughened by irregular branching transverse lines. Metatibia with a series of narrow elongate punctures paralleling the lower margin from near base almost to apex, most of them so close as to form a continuous groove. Abdominal sternites strigate at sides, last visible sternite strigo-rugose at each side.

Male. Length 10.25 mm.; width 5.75 mm. Form more depressed than in female (holotype) above described. Pro- and mesotarsi a little broader than in female, three basal segments clothed beneath with pads of golden hairs which are not dilated apically. Anterior protarsal claws a little thicker than their fellows, a little broadened towards base. Aedeagus (apex damaged in allotype) of the same type as that of *brevicollis* or *seriatus*.

Holotype—♀, Eel River, Pepperwood, Humboldt Co., California, May 16, 1938 (H. B. Leech), in the California Academy of Sciences (Entomology), San Francisco.

Allotype—♂, Mendocino, Mendocino Co., Calif., June 30, 1940 (J. R. Helfer). No. 5352 in the Canadian National Collection, Ottawa.

Paratypes—1 ♀, same data as allotype, August 11; 3 ♂♂, 4 ♀♀, Mendocino Co., Calif., May 22, 1938 (F. W. Nunenmacher). A very teneral male from Amador Co., Calif., has been seen; it appears to be *pandurus*. Seven paratypes returned to Mr. Nunenmacher, two in my collection.

Agabus pandurus has long been confused with *brevicollis* Leconte. Their ranges overlap in the region of the Sacramento River, *pandurus* occurring chiefly northwest of the river, along the coast, while *brevicollis* is found from just north of San Francisco, south to at least Monterey. The type of *brevicollis* is from the "Upper Sacramento river; Mr. Child" (Leconte, 1860:34); on page 2 of the same paper, Leconte refers to collection No. 10 "Two collections made, the one in the Sacramento valley, the other at San Francisco, by Mr. J. Child." There is no way of telling just how far up the river Leconte's two original specimens were taken, or even if they were found at the same place; the second example is the one loaned to David Sharp when he was preparing his monograph on the Dytiscidae and proves to be the species here described as *pandurus*. Dr. P. J. Darlington, Jr., has compared some of my specimens with Leconte's type.

A. pandurus may be separated from *brevicollis* by its broader metasternal wings (compare figs. 1 and 2), its rougher elytral and metacoxal sculpture, and its distribution. Extensive collecting may prove that one is but a northern subspecies of the other, since a small variation has been noticed in the shape of the metasternal wings, which are variable in the allied *A. seriatus intersectus* (Crotch).

***Agabus vandykel* n. sp.**

A dull black species, resembling a small *A. confertus* Leconte, but more parallel-sided, as in *gelidus* Fall; most closely related to *A. verisimilis* Brown.

Male. Length 7.5 mm., width 3.75 mm. Body oblong-oval, sides feebly arcuate, surface rather dull. Black, vaguely aenescant; mouth parts and antennae rufous, not infusate; two rufous spots on vertex; pronotum narrowly rufous at sides; each elytron with a vague dark rufous vitta from humerus to near apex.

Undersurface black, apices of abdominal sternites rufescent; prosternal process dark rufous; tarsi, tibiae, femora and trochanters rufous to piceous, the femora darkest. Head slightly more than seven-tenths width of pronotum; meshes of surface reticulation small and unequal, irregular in shape; small punctures occurring irregularly, both within the meshes and at their intersections. Pronotum two and one-half times as broad as long; sculpture as on head, except for transverse series of coarser punctures paralleling anterior margin, and one along each lateral third at base; lateral marginal bead very narrow, much less than one-half width of an antennal segment. Elytral sculpture as in head and pronotum, reticulations more deeply engraved, the meshes subdivided by a secondary or microreticulation, especially laterally and apically. Prosternal process short, a little wider than a median antennal segment is long, angulate and roof-shaped in cross-section. Metasternal wings moderately broadly triangular; least distance between mesocoxa and metacoxal plate slightly more than one-half width of latter, measured along the same line. Metacoxal plates microreticulate, the surface further roughened by irregular branching lines. Metatibia with a few elongate punctures along inner (lower) edge. Abdominal sternites faintly strigate at sides; last visible sternite flattened medially. Pro- and mesotarsi only slightly broader than in female, three basal segments clothed beneath with pads of golden hairs which are just visibly spatulate apically; anterior protarsal claw straighter than in female, posterior slightly widened at middle.

Female. Similar to the male except for secondary sexual characters; elytral surface strongly microreticulate, hence duller than that of male.

Holotype—♂, Yosemite, California, August, 1935 (E. S. Ross). Lacks apical half of right antenna, and right metatarsus; genitalia extracted and mounted on a card below beetle; in the collection of the California Academy of Sciences (Entomology), San Francisco.

Allotype—♀, Tallac, California, July 14, 1898 [A. Fenyès, collector]. No. 5353, in the Canadian National Collection, Ottawa.

Paratypes—1 ♂, 2 ♀♀, same data as allotype; 1 ♀, Tallac, California (Dr. A. Fenyès), carrying an identification label "hypomelas"; 1 ♀, "Gln Alpine, Cal", July 1, 1905 [A. Fenyès]; 1 ♀, Marble Fork, 7,000 ft., Tulare Co., California [R. Hopping]; 3 ♂♂, 3 ♀♀, Paradise Meadow, Jack Main Canyon, Yosemite, Calif., 7,700 ft., July 27, 1937 (E. Herald); 1 ♂, Mary Lake, Tuolumne Co., Yosemite, Calif., 9,800 ft., July 30, 1937 (E. Herald). Some paratypes are a little larger or smaller than the type, and a few from Paradise Meadow are teneral. Tallac and Glen Alpine are near the south end of Lake Tahoe, in Eldorado Co., Calif.

Paratypes will be distributed as follows: a pair to Mr. Earl Herald, one specimen each to Messrs. J. B. Wallis, G. R. Hopping, H. P. Chandler, one male to the British Museum; the remainder in my collection.

A. vandykei was recognized as a new species many years ago by Dr. E. C. Van Dyke, for whom it is named. It is most commonly found mixed with *A. confertus* collections, but that species is larger and more convex, has the pronotal lateral margins more than half the width of an antennal segment, and has the last sternite strigate at each side of the middle in the male. *A. vandykei* is close to *verisimilis*, a species occurring in British Columbia, but is less parallel-sided, more robust, and not so shining. The very narrow lateral margins of the pronotum appear to associate the new species with *irregularis* Mannerheim, *hypomelas* Mann., *vancouverensis* Leech, and their allies of the palaeartic fauna, *chalconatus* (Panzer) and *melanocornis* Zimmermann, though the two latter have broader margins. Careful study may show that all the species of the *confertus* group can be similarly associated.

Agabus griseipennis Leconte

Agabus griseipennis Leconte, 1859. Smithsonian Contrib. Knowledge, 11:5.

The recognition of this species has always been troublesome. Leconte described *griseipennis* from a single female from Fort Laramie, Wyoming. He never definitely associated males with the type, but suggested that the latter might really be the other sex of his *lutosus* from San Francisco, Calif., and of which he then had only males.

Fall (1922) recognized the males of *griseipennis*, and separated them from those of *lutosus* by their relatively wider protarsi, their apically bifid rather than medially toothed anterior protarsal claws, and upon distributional data. Even with these definite statements, confusion results. On examining the inner protarsal claws of large series of males presumed, from locality labels, to be *lutosus*, specimens are found in which the claw is almost apically bifid and unlike that of typical *lutosus*, yet subtly different from that of *griseipennis*. Such examples have caused most students to doubt the validity of *griseipennis*, especially since the width of the protarsi is variable in *lutosus*.

A careful examination of the male protarsi in the two species, shows that they can be clearly and definitely separated by the chaetotaxy of the apical segment (figs. 11 and 12), and that the shape of the anterior claw of *griseipennis* is distinctive. The chaetotaxy has shown no variation in the 672 males of *lutosus* studied, and is equally constant in the thirty-two males of *griseipennis*. As yet, no characters have been noted which will separate the females of the two species. In males of *griseipennis*, the meshes of the elytral sculpture are small, rounded and equal throughout.

Fall (1922:23) gave the distribution of *griseipennis* as "Wyoming (Fort Laramie—type); Montana (Kalispel—Wickham); New Mexico (Ft. Wingate—Sherman collection); Nevada (a male in the Sharp collection correctly referred); Humboldt Lake, Nevada (Wickham collection); Owen Lake, California (G. R. Pilate)." I suspect that the Kalispel, Mont., specimens will prove to be *lutosus*; all examples from Fernie, B. C., and Cypress Hills, Alta., are that species. I have seen *griseipennis* from, UTAH: Far West; Grantsville; Skull Valley; Provo; CALIFORNIA: Lone Pine, Inyo Co.; Bodie, Mono Co.

Since the two sexes of *griseipennis* differ markedly in sculpture, an allotype should be described and designated. It seems best to wait until collections made at the type locality give definite proof that the male of *griseipennis* has been correctly associated by Fall and myself.

In habitat this species differs somewhat from *lutosus*, preferring brackish water, especially the shallow weedy shores of lakes. In eastern California it is found in company with *A. disintegratus* (Crotch).

Agabus lutosus lutosus Leconte

Agabus lutosus Leconte, 1853. In Melsheimer's Cat. descr. Coleoptera U. S., p. 31. NOT *A. lutosus* Crotch, 1873, which is *A. erichsoni* G. & H.

Agabus discolor Leconte, 1852. Ann. Lyceum Nat. Hist. New York, 5:204. NOT *A. discolor* (Harris) 1828.

Gaurodytes lecontei Crotch, 1873, Trans. American Ent. Soc., 4:417.

Type locality (*discolor* Leconte): "San Francisco, et Vallecitas", California. Dr. P. J. Darlington Jr., has very kindly compared some of my specimens with Leconte's type.

From San Diego Co., Calif., north to Vancouver, B. C., thence eastward to southern Alberta and Nevada, *lutosus* is the commonest species of *Agabus*. It occurs typically in the quiet weedy parts of streams with bed and banks of fine gravel, sand or clay, but also in ponds, especially during the spring and fall flights.

As mentioned under *A. griseipennis*, the anterior protarsal claws of the male of *lutosus* vary a good deal in shape, and in some types simulate the former

species; the chaetotaxy of the ultimate tarsal segment will place all doubtful specimens (figs. 11 and 12). The most *griseipennis*-like form is seen in males from Alberta, and as these specimens are also paler and more elongate, they may constitute a valid subspecies.

The elytral sculpture differs greatly between the two sexes. In females the sculpture is coarse and deeply impressed; the meshes are of unequal shapes and sizes, except basally and on the disk where they are usually narrow and greatly elongated. In the males the elytra are shiny, with a lightly impressed reticulation; the meshes are small, and either rounded and nearly equal except basally near the suture, or of unequal shapes and sizes almost throughout (type), or intermediate between these conditions. In a series of over 300 males before me, from California to central and southern British Columbia and Cypress Hills, Alberta, about seventy-five per cent have the meshes equal; all degrees of mesh-shapes occur throughout the range of the species, except in the subspecies described below.

***Agabus lutosus mimus* n. subsp.**

In examining a large series of males of *lutosus*, it was noted that although specimens from California, Nevada, eastern Oregon and Washington, British Columbia east of the coast mountains, and southern Alberta, agreed as to the elytral sculpture, specimens from coastal British Columbia and Mt. Rainer in Washington could be separated at a glance. In these one finds the same variation in the shapes of the meshes as in typical *lutosus*; but the whole elytral sculpture is much more deeply impressed and rougher, and the elytra consequently less shining. Such specimens apparently occurring only in the northern coastal region, are here designated as the subspecies *mimus*, n. subsp.

Holotype ♂, and *Allotype* ♀, on the same pin and taken *in coitu*, are from the Library lily pond on the campus of the University of British Columbia, Vancouver, B. C., January 28, 1931 (Hugh B. Leech). No. 5356 in the Canadian National Collection, Ottawa.

Paratypes (all males) BRITISH COLUMBIA: 3, Vancouver, June 3, 1930 (H. Leech), from pools near Library on the University campus; 1, same data, February 1; 4, Grouse Mountain, elev. 4200 ft., Vancouver, June 7, 1931 (Hugh B. Leech); 3, Hollyburn Ridge, Vancouver, June 28, 1931 (H. B. Leech); 1, Stanley Park, Vancouver, June 26, 1935 (K. Graham); 1, Steelhead, September 8, 1933 (H. B. Leech); 3 Steelhead, May 3, 1934 (K. Graham); 2, Langley, June 21, 1931 (K. Graham), and 2, same data, January 2, 1935; 1, Stanley Park [Vancouver], September 19, 1926 (C. R. Asher), and 1, same data, ("K. F. M."); 2, Vancouver, November 5, 1937 ("J. F. D."); 1, Vancouver, September 30, 1932 ("M. B."); 2, U. B. C. [Vancouver], May 25, 1927 (G. J. Spencer); 1, Point Grey [Vancouver], October 26, 1928 (Josephine Hart), and 1, same data, October 12; 1, Lake at head of Cottonwood Creek, Cowichan Lake, Vancouver Island, B. C., August 11, 1940 (K. Graham). WASHINGTON: 10, Mt. Rainier, July 21, 1934 (R. Hopping); 5, same data, G. Hopping; 1, Paradise Valley, Mt. Rainier, July 18, 1920 (E. C. Van Dyke).

Paratypes will be distributed as follows: 4 to the Canadian National Collection, Ottawa; 9 to the Department of Zoology, University of British Columbia, Vancouver; 3 to the California Academy of Sciences (Entomology), San Francisco; 1 to the British Museum (Nat. Hist.), London; 1 to the Museum of Comparative Zoology, Cambridge, Mass.; 8 to Mr. G. Hopping, Vernon, B. C.; 1 to each of the following persons: Messrs. J. B. Wallis, Winnipeg, Man.; Frank Young, Gainesville, Fla.; H. P. Chandler, Provo, Utah; Dr. M. H. Hatch, Seattle, Wash., and G. Stace Smith, Creston, B. C.

Females have been seen from all the localities mentioned above, and although they are of course part of the breeding population of the subspecies

mimus, for practical reasons none has been made a paratype. The subspecies can be recognized with certainty only by the elytral sculpture of the males; females of typical *A. lutosus* and of *A. lutosus mimus* seem to be indistinguishable, except that the latter average a little darker.

The range of this subspecies is not fully known. One male from Steelhead (a village in the hills, about nine miles north of Mission, B. C.) is *lutosus lutosus*, while the other four are *lutosus mimus*; this suggests that the latter does not extend eastward to the coast mountains, the usual faunal division between the coast and interior species of southern British Columbia. All specimens which I have seen from Mt. Rainier, Wash., are the subspecies *mimus*, but a male from Monroe, Wash., is *lutosus lutosus*; it may be that altitude is the factor in this instance, though obviously not significant at Vancouver, B. C. Practically all examples of the species from western Oregon (Corvallis, McMinnville, Ashland, Medford, Pistol River, Florence) have the elytral meshes largely or entirely of unequal sizes, but only one example (McMinnville, Ore., April 8, 1936, K. Fender Collr.) in any way approaches *lutosus mimus* in roughness of sculpture.

The subspecies has been found only in pools and ponds. The paratypes from Grouse Mountain and Hollyburn Ridge, B. C., were taken in pools freshly formed by melting snowbanks, while the one from Stanley Park at Vancouver was in the brackish Lost Lagoon, at sea level.

***Agabus obliteratus* Leconte**

Agabus obliteratus Leconte, 1859. Smithsonian Contrib. Knowledge, 11:5.

A study of the material under this name in collections, has shown it to be composite. One of the species involved, described elsewhere in this paper as *hoppingi* mihi., is easily recognized by the inflated sides of the pronotum, the finer elytral sculpture (male), and the male genitalia. The other, *nectris* mihi of this paper, is distinguished by the presence of numerous small elongated punctures on the inner face of the metatibia. This is not a very significant character, in that it is slightly variable in *morosus* and allies, and I would much rather have described *nectris* as a subspecies of *obliteratus*. But as none of the 87 *obliteratus* before me shows any sign of these punctures, while the 382 *nectris* invariably have them, it seems that the latter should stand as a good species.

In his key, Fall (1922) separated *obliteratus* from *morosus* by the epipleurae being entirely black in the latter, but with a pale outer margin in the former. These characters do not hold; one finds both in each species, as in the allied *nectris*. The elytral coloration is similarly variable in these species.

Of *A. obliteratus* Fall says, "Occurs in the Rocky Mountain region from Wyoming to New Mexico. . . I have seen examples from: COLORADO, Lyon; Willow Pass, 9,000 ft.; UTAH, Farmington; Hyde Park; Logan; PROVO; NEVADA, Reno; Zephyr Canyon, Lake Tahoe; CALIFORNIA, Bodie, Mono Co.; Cayton, Shasta Co.; Chester, Plumas Co.; Round Meadow, Giant Forest, Tulare Co., Mohave, Kern Co.

***Agabus nectris* n. sp.**

A medium sized species, closely resembling *Agabus obliteratus* Leconte (*q.v.*) and *A. morosus* Leconte.

Male. Length 7.75 mm.; width 4.0 mm. Shining, metacoxal plates duller. Head black, except for mouth parts, labrum, antennae, and two spots on vertex, which are yellowish-brown; outer antennal segments slightly infusate apically. Pronotum black, lateral marginal beads rufescent. Elytra piceous apically, paler basally and yellowish-brown laterally. Under surface black, epipleurae narrowly brownish externally; femora largely black, pro- and mesotibiae, trochanters and

tarsi brownish; abdominal sternites brownish along posterior margins. *Head* reticulated, the meshes of unequal sizes and shapes. *Pronotal* meshes, especially discally, larger and less deeply impressed than those of head. Lateral marginal beads as wide as base of an outer antennal segment. *Elytral* reticulation lightly impressed, meshes about the same size as those of head, some with a tiny puncture near the center; serial punctures large and numerous. *Prosternal* process lanceolate, sharp apically, narrowly margined, and on a lower plane than that portion anterior to the procoxae. Three basal segments of pro- and mesotarsi dilated, clothed beneath with hairs which are expanded apically to form rounded or somewhat oval palettes. Protarsal claws almost alike, elongate, sinuate on internal margin, straight on outer, curved apically. Metatibiae without a series of punctures paralleling the lower margin, but with numerous small elongated punctures over almost the entire face. *Aedeagus* bifid near apex in profile, see fig. 5.

Female. Darker than male dorsally; pro- and mesotarsi simple. Sculpture of head, pronotum, and elytra, except apically, consisting of a deeply impressed reticulation, the meshes more nearly equal in size than those of male.

Holotype ♂ and *Allotype* ♀ from a weedy ditch, Lumby, B. C., September 20, 1939 (H. B. Leech). No. 5355 in the Canadian National Collection, Ottawa.

Paratypes—31 ♂♂, 15 ♀♀, same data as holotype; 3 ♂♂, 1 ♀, Vernon, B. C., October 20, 1934 (H. Leech); 2 ♂♂, Vernon, B. C., May 2, 1935 (Hugh Leech); 4 ♂♂, 3 ♀♀, same data, June 9, 1937; 3 ♂♂, 1 ♀, same data, August, 25; 5 ♂♂, 4 ♀♀, same data, April 15, 1939, 4 ♂♂, Salmon Arm, B. C., December 27, 1929 (Hugh B. Leech); 7 ♂♂, 5 ♀♀, same data, May 24, 1937; 1 ♂, 1 ♀, ephemeral pool, Salmon Arm, B. C., March 25, 1941 (Hugh Leech); 1 ♀, Inonoaklin River, near Needles, B. C., April 19, 1941 (Hugh Leech); 1 ♂, Falkland, B. C., September 16, 1932 (A. Thrupp); 1 ♀, Nicola, B. C., April 10, 1935 (H. Leech); 5 ♂♂, 1 ♀, pool in muddy stream, Jackass Mtn., Fraser Canyon, B. C., May 30, 1940 (H. B. Leech); 1 ♂, 1 ♀, irrigation ditch, Ashcroft Manor, B. C., May 30, 1940 (H. B. Leech); 5 ♂♂, spring near Lac du Bois, Kamloops, B. C., September 3, 1939 (Hugh Leech); 1 ♂, Kamloops, B. C., August 6, 1939 (G. J. Spencer); 10 ♂♂, 14 ♀♀, pond No. 2, Osoyoos, B. C., March 29, 1941 (H. B. Leech); 1 ♀, same locality, pool in sand near Osoyoos Lake; 4 ♂♂, 2 ♀♀, Creston, B. C., April 28, 1932 (G. Stace Smith); 6 ♂♂, 4 ♀♀, same data, April 29; 4 ♀♀, Copper Mtn., B. C., March 17, 1939 (G. Stace Smith); 1 ♂, same data, May 11, 1930; 1 ♂, 2 ♀♀, same data, March 30, 1930; 1 ♀, same data, April 6, 1927; 1 ♀, same data, December 1, 1929; 2 ♀♀, same data, April 3, 1929; 5 ♂♂, 6 ♀♀, Wynndel, B. C., May 10, 1931 (G. Stace Smith).

Paratypes will be distributed as follows: three pairs to the Canadian National Collection, two pairs each to the U. S. National Museum, the Museum of Comparative Zoology, the British Museum (Nat. Hist.) and the California Academy of Sciences; 8 ♂♂, 14 ♀♀, to Mr. G. Stace Smith, Creston, B. C.; 6 ♂♂, 4 ♀♀ to G. R. Hopping, Vernon, B. C.; and one pair each to Messrs. J. Balfour-Browne, London; J. B. Wallis, Winnipeg, Man.; F. N. Young, Gainesville, Fla.; H. P. Chandler, Provo, Utah; B. Malkin, Eugene, Ore.; Dr. M. H. Hatch, Seattle, Wash.; and Prof. G. J. Spencer, Vancouver, B. C.; the remainder in my collection.

The paratypes vary from 6.5 to 8.0 mm. in length; the elytra vary from piceous to yellowish-brown, and the epipleurae may be entirely black, or margined laterally with brown. The elongate punctures on the face of the metatibiae are more numerous in some specimens than in others, but are always readily seen with a magnification of 20x or more.

Agabus nectris is most closely allied to *obliteratus* Leconte but can be

separated from that species by the presence of numerous small elongate punctures on the face of the metatibiae; this character holds for the 382 specimens of *nectris* and the 87 of *obliteratus* which I have studied. The male genitalia of the two are very similar and apparently cannot be used to distinguish them. *A. nectris* also resembles *morosus* Leconte, but these two can be separated by the shapes of the aedeagus; compare figs. 5 and 7.

In addition to the localities mentioned in the paratype series, I have seen examples of *nectris* from the following places in British Columbia: Basque, Fort Steele, Trinity Valley, Lavington, Aspen Grove, Hefley Lake, 134 Mile House on the Cariboo Road; also specimens from Medicine Hat and Pincher Creek, Alberta, and Shields River, Bitter Root Valley, Bozeman in Lewis and Clark Co., Montana. A series from Trinity Valley, B. C., all collected in June, July and September, 1939 (J. R. L. Howell) average a little larger, and are narrower anteriorly and posteriorly; they may warrant a subspecific name.

The immature stages are unknown. Teneral adults have been taken as follows: Jackass Mountain, May 30, 1940; Basque, July 4, 1933; Vernon, August 15 and 25, 1937; Hefley Lake, September 2, 1932; Lac du Bois, Kamloops, September 3, 1939; Copper Mountain, September 30, 1929. *A. nectris* is typically a species of small weedy streams with but little current. The paratypes from Osoyoos were taken in a pond, but many stream species are found in ponds and lakes early in the season when they are actively searching for suitable breeding quarters. A pair taken at Vernon, B. C., on April 20, 1936 (A. A. Denny), had alighted on the shiny roof of a new car, apparently mistaking it for water.

Agabus hoppingi n. sp.

A brown and black species closely resembling *A. obliteratus* Leconte, from which it may be distinguished by the following characters: Sides of pronotum inflated towards the front, as seen laterally, the marginal bead thus broadened and flattened anteriorly, where it is less distinct. Meshes of elytral reticulation (male) of irregular sizes and shapes, but small, as in *A. lutosus lutosus* Lec., only about one-third as large as in *obliteratus*. Apex of aedeagus (fig. 9) recurved, hooded, the hood almost hiding the subapical tooth (profile) typical of species in this section of the genus. In all other major characters, this species resembles *obliteratus*.

Holotype—♂, Gray Meadow, Lot 13, Tulare Co., California, July 3, 1913 [collected by Ralph Hopping]. No. 5354 in the Canadian National Collection, Ottawa.

Allotype—♀, Grouse Meadow, Tulare Co., California, June 28, 1913 (Hopping). In the Canadian National Collection.

Paratypes—two males, same data as the holotype; one in Mr. Hopping's collection, one in mine.

The three males are teneral. It is surprising to find such distinctive characters in a series which is otherwise so like *obliteratus*; in fact I saw a male of *hoppingi*, from another locality, in Mr. A. T. McClay's collection in 1937, but because of the recurved tip of the aedeagus, regarded the specimen as probably abnormal. The palaearctic *A. paludosus* (F.) has the tip of the aedeagus, distinctly recurved, but it is not closely allied to *hoppingi*.

It is a pleasure to dedicate this species to the late Ralph Hopping, the collector, and my mentor in systematics.

The *Agabus obsoletus* complex

There are at least two species in this complex, and three names have been applied to them. The larger one occurs chiefly along the coast, from San Diego, Calif. (type locality), to the peninsula of San Francisco proper, and is *obsoletus* Leconte, 1858. This species was described as .33 of an inch long, or

slightly over 8 mm., which is the average size of the specimens before me, including a topotypical male. The aedeagus of the male genitalia is broad and flat on the dorsal (concave) side and is narrow apically (fig. 10).

I have seen specimens from San Diego and other places in San Diego Co., Mercy Springs, San Benito Co.; and San Francisco, San Francisco Co. Two specimens from the ecologically very different Inyo Co. (δ , 7.5 mm. long, Bishop, Calif., 18.IV.38, T. Aitken; η , 7 mm. long, 6 mi. N. W. of Lone Pine, Calif., 16.VI.37, C. D. Michener) may represent a subspecies; the aedeagus is typical of *obsoletus*.

The second species occurs from the east and north shores of San Francisco Bay, north at least to Trinity County and probably into Oregon. It averages 7 mm. long, is narrower and flatter than *obsoletus*, the aedeagus is rounded, not flat, in the basal two-thirds of the dorsal side, and the apex is relatively broad (fig. 7).

In 1852 Leconte described *A. morosus*, from San Francisco, based on a female .29 inch, or just over 7 mm. long. (Since males are needed for a final determination of the species, it is difficult to prove that this Bay-region-and-northward species is *morosus*. But I have had a female 7 mm. long, from Napa Co., compared with Leconte's type by Dr. P. J. Darlington, Jr., who writes "Your *A. morosus* does compare well with the type in form and appearance, except the type is slightly larger than yours." This, though not conclusive, leads me to accept my identification.

The third name is *A. fossiger* (Motschulsky), 1859. Motschulsky's species was placed as a synonym of *morosus* by Horn (1883, Trans. American Ent. Soc. 10:281), and later writers have followed him. The type locality for *fossiger* is San Francisco, and the length is given as $3\frac{1}{4}$ lines, or just less than 7 mm. This measurement precludes coastal *obsoletus*, and as the description fits my conception of *morosus*, I accept Horn's synonymy.

I have seen *A. morosus* from the following localities, all in CALIFORNIA: Napa Co.: Sequoia Resort; St. Helena Creek. Contra Costa Co.: Orinda, Sonoma Co.: Santa Rosa, Mendocina Co.: Mendocina; Caspar; 5 mi. S. of Willits. Humboldt Co.: Blocksburg; Fort Seward. Trinity Co.: Carrville.

Agabus ancillus Fall.

Agabus ancillus Fall, 1922. Rev. N. Am. spp. *Agabus*, p. 24.

In addition to its smaller size and less convex form (profile), this species can be separated from the allied *morosus* by the shape of the aedeagus. In *ancillus* the apical third of this organ is laterally compressed, while in *morosus* it attains almost its maximum width in the same distance; compare figs. 6 and 7.

Fall's specimens were from Gaston (type) and Corvallis, Ore. I have examples from: OREGON, Dilley; Baker Creek; Medford; Scott Lake, Lane Co. CALIFORNIA, Humboldt Co. BRITISH COLUMBIA, Point Gray, Vancouver.

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EXPLANATION OF PLATE X

Figs. 1 to 4, metasterna of *Agabus pandurus* n. sp., *A. brevicollis* Leconte, *A. seriatus seriatus* (Say) and *A. seriatus intersectus* (Crotch); all drawn to the same scale. Figs. 5 to 10, aedeagus of male genitalia (profile) and view of apical third of aedeagus, dorsal view, of *Agabus nectris* n. sp., *A. ancillus* Fall, *A. morosus* Leconte, *A. seriatus* (Say), *A. hoppingi* n. sp., and *A. obsoletus* Leconte; all drawn to the same scale. Figs. 11 and 12, ultimate protarsal segment and anterior protarsal claw, lateral and ventral views, of *Agabus lutosus* Leconte and *A. griseipennis* Leconte; drawn to the same scale.

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